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Seven Traits of a Healthy Control Chart

By Matt Savage & Steve Daum

Is the control chart you are using healthy? Does it include relevant information to help gain insight about your process?

Control charts are valuable tools to help you and your team implement fundamental process changes to improve manufacturing processes. But before you can effectively utilize the information from the chart, you must first be confident that the chart being reviewed is healthy. Just as you wouldn't perform elective surgery on a patient with an infection, you shouldn't analyze a control chart without first considering seven key traits.

Software is an invaluable tool for creating control charts; however, great diversity among software programs exists. When choosing statistical process control (SPC) software, use these seven traits as a guide.

1. Screen for excessive variation
2. Clear, extensive, and accurate titles
3. Underlying data visible on the chart
4. Control limits reflect process change
5. Out-of-control conditions clearly identified
6. Assignable causes shown but not used in overall calculations
7. Annotations used to increase understanding

When choosing control charting software, use these seven traits as a guide.

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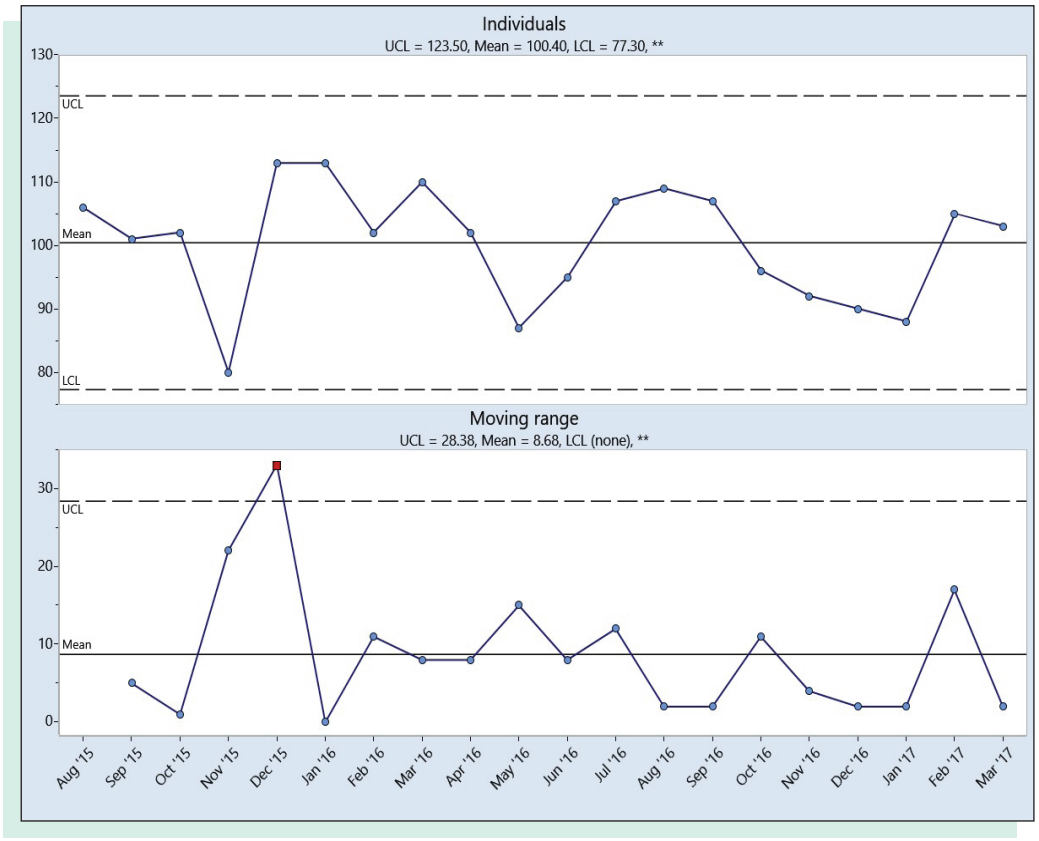
1. Screen for excessive variation

An important part of interpreting control charts is identifying special causes. A sudden change in your data may render the moving range out of control. This spike in the moving range artificially widens the control limits on the individuals chart, making it more difficult to identify special causes. By not catching a sample that is out of control, you can miss an opportunity for improvement.

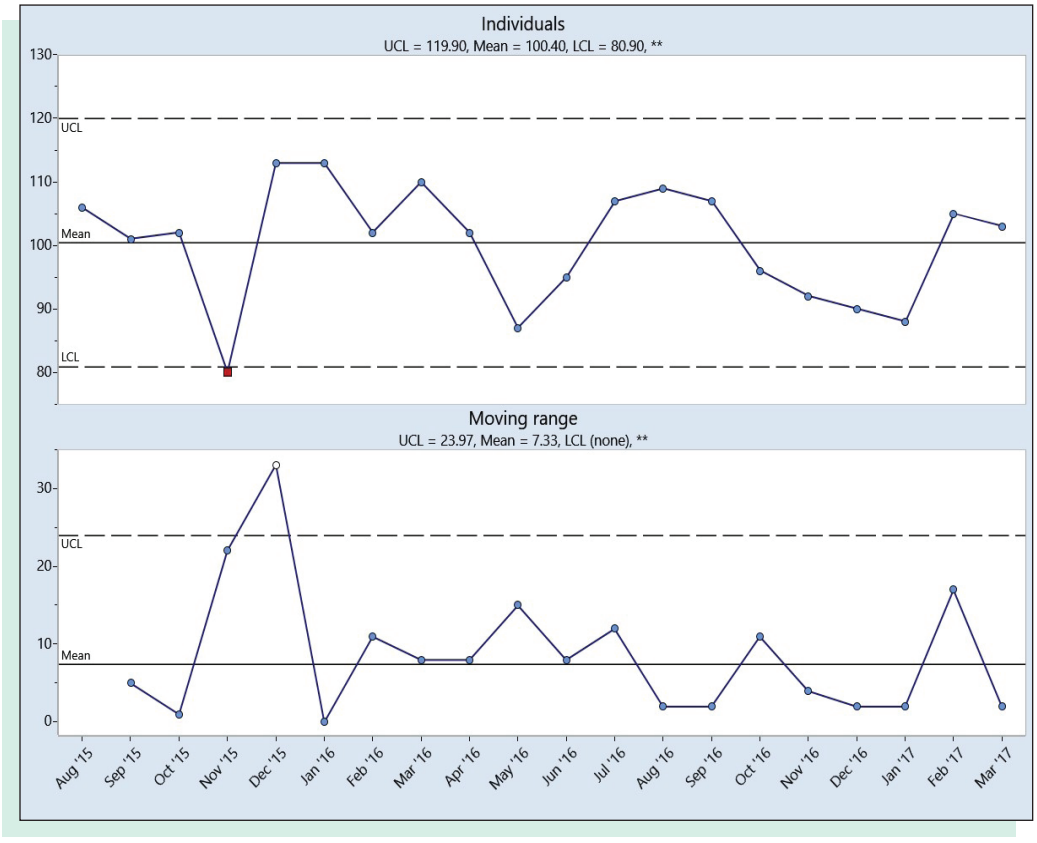
Note this chart with the out-of-control point on the moving range chart. The individuals chart, however, appears to be in control.



Screening for excessive variation renders individuals charts more effective in identifying special causes by removing any moving range values that are above the upper control limit (UCL). This can be a better option than marking the sample as a special cause. When a sample is marked as a special cause, it is eliminated from both the moving range and the individuals chart calculations. By screening for excess variation, it is removed from the moving range and keeps the sample on the individuals chart. Make sure your software provides the option to screen for excessive variation so that you don't miss any opportunities for improvement.

Here are the same two charts shown on the previous page, using the screening option. There is clearly an out-of-control condition on the individuals chart that was "missed" using traditional techniques.

This procedure was suggested by Lloyd Nelson in the Technical Aids section of the Journal of Quality Technology (Vol. 14, No. 3, Pg. 172, July 1982). Lloyd Provost and his colleagues at Associates in Process Improvement (API) have popularized this method.



2. Clear, extensive, and accurate titles

On any control chart, the metric being evaluated should be obvious at a glance. The chart may require additional explanatory titles, but one title, probably at the top, should be larger than the others and clearly name the metric being considered.

Since the name of some metrics may be obscure, additional titles may be necessary to help the viewer understand where the data comes from, how it has been gathered, and what time frame is represented in the chart. Although the chart should not be cluttered, several titles both above and below the control chart can make it much easier for a viewer of the chart to understand what is being presented.

If any part of the title information is inaccurate or out of date, the viewer will immediately question the entire chart. Choose software that can ensure that your chart titles are current. For example, when a date is used as one of the titles, rather than changing the date each time the chart is generated, use software that employs a title code (such as @DATE) to represent the current date and ensure that titles are current and useful every time the chart is generated.

Compare the charts on the next page and see which one is preferable.

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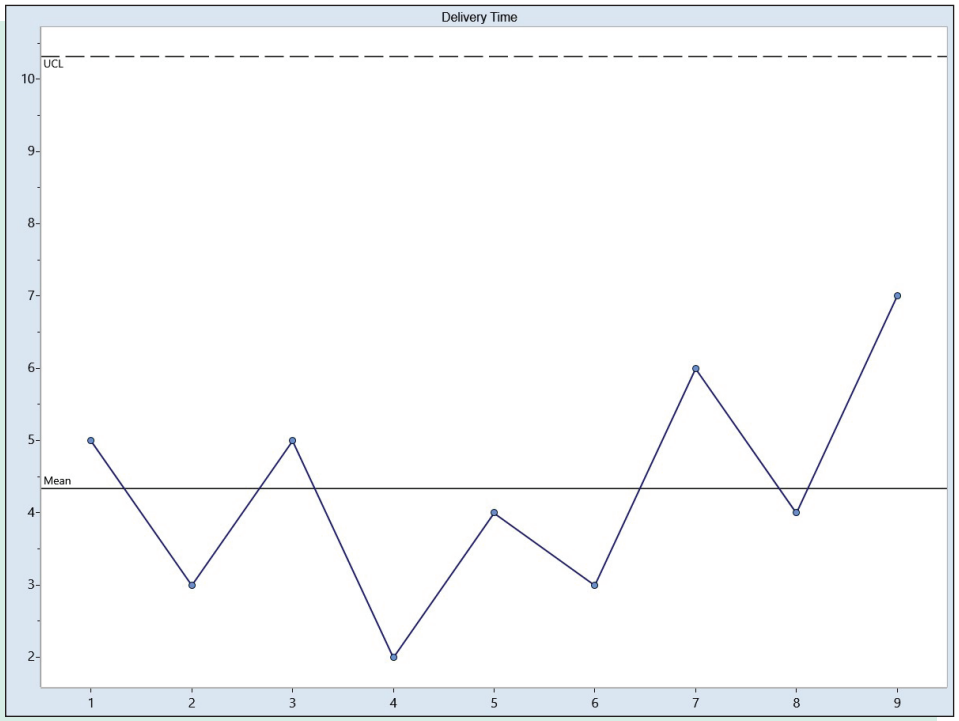
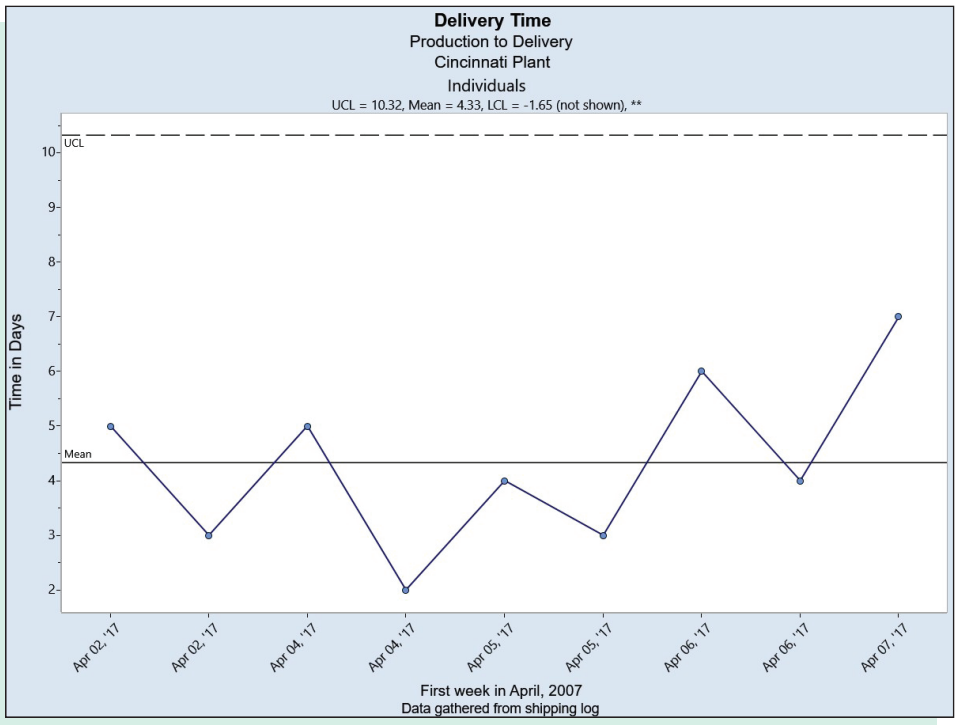
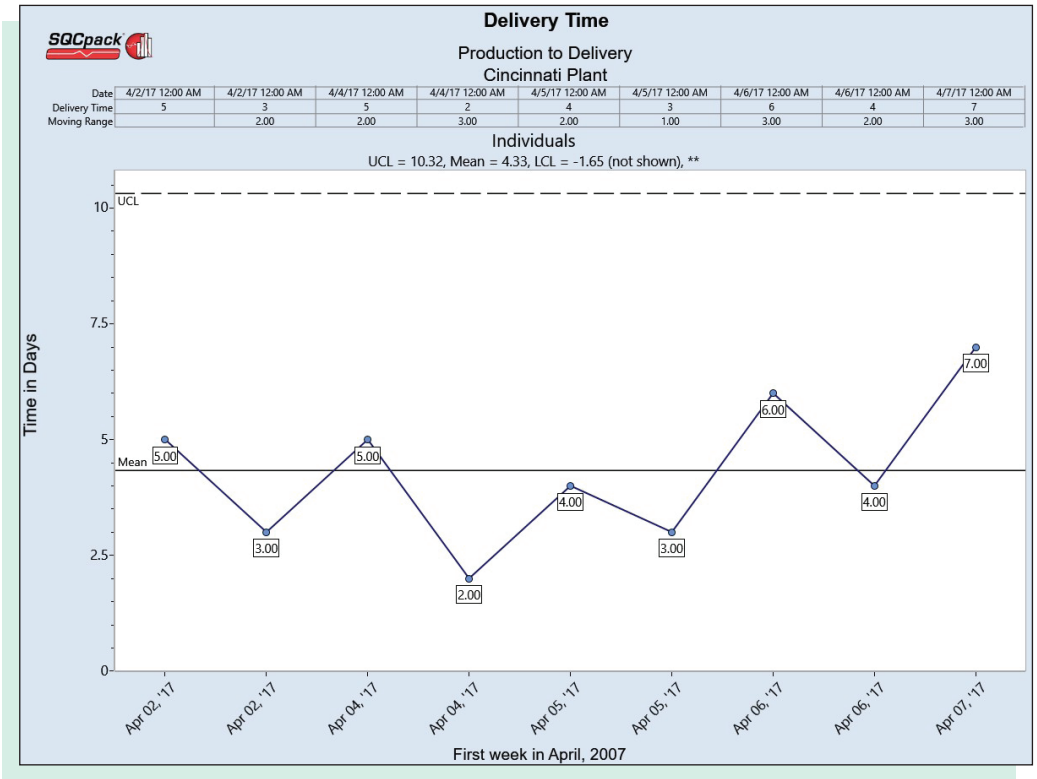

Delivery Time
UCL
Mean
10
9
8
7
6
5
4
3
2
1
2
3
4
5
6
7
8
9


Delivery Time
Production to Delivery
Cincinnati Plant
Individuals
UCL = 10.32, Mean = 4.33, LCL = -1.65 (not shown), **
UCL
Mean
Time in Days
10
9
8
7
6
5
4
3
2
Apr 02, '17
Apr 02, '17
Apr 04, '17
Apr 04, '17
Apr 05, '17
Apr 05, '17
Apr 06, '17
Apr 06, '17
Apr 07, '17
First week in April, 2007
Data gathered from shipping log

3. Underlying data visible on the chart

To evaluate a control chart, you look for exceptional cases. Points beyond the control limits are the best example, but other data points might raise questions as well. These exceptional points demand more information. What is the actual data value? When was the data value gathered? Who recorded the data?

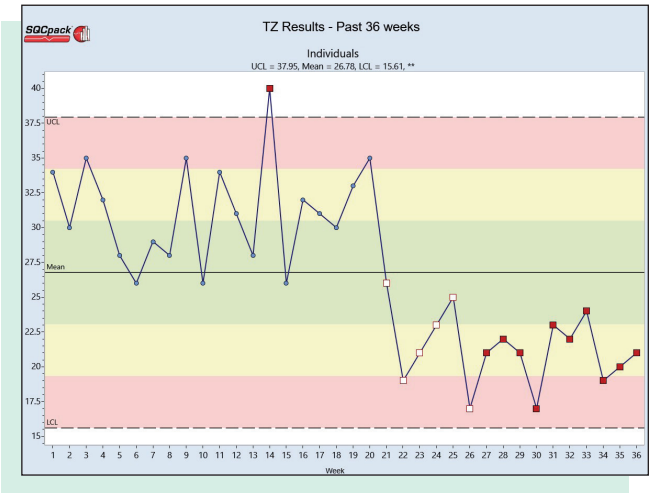
Your software should offer the option to make this additional identifying information visible on the chart, so that when you look at an exceptional point, it is possible to glean additional information to understand what has happened. Displaying the data value near the plotted point can help in understanding the exceptional points. This allows the viewer to see the number immediately, rather than looking over to the y-axis and trying to guess what the value is.

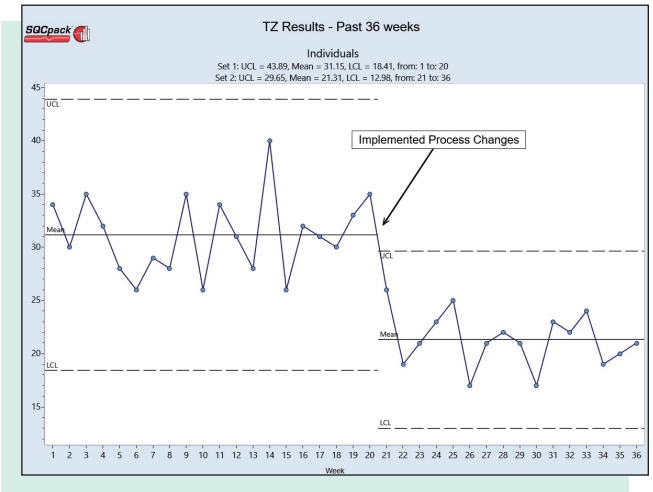


4. Control limits reflect process changes

When using control charts for process improvement, you can expect to see changes in the process over time. As a process improves, adjust the control limits to reflect the new reality. If the data on a chart shows a significant improvement or change, the chart should communicate this with multiple sets of control limits. For example, it might be useful to see one set of limits before the improvement, and another set of limits after the improvement. This visualization of an improving process can be a powerful way to communicate feedback to workers in the process, management, board members, and other stakeholders.

Here is the same data set shown with one set of control limits vs. two sets of control limits.





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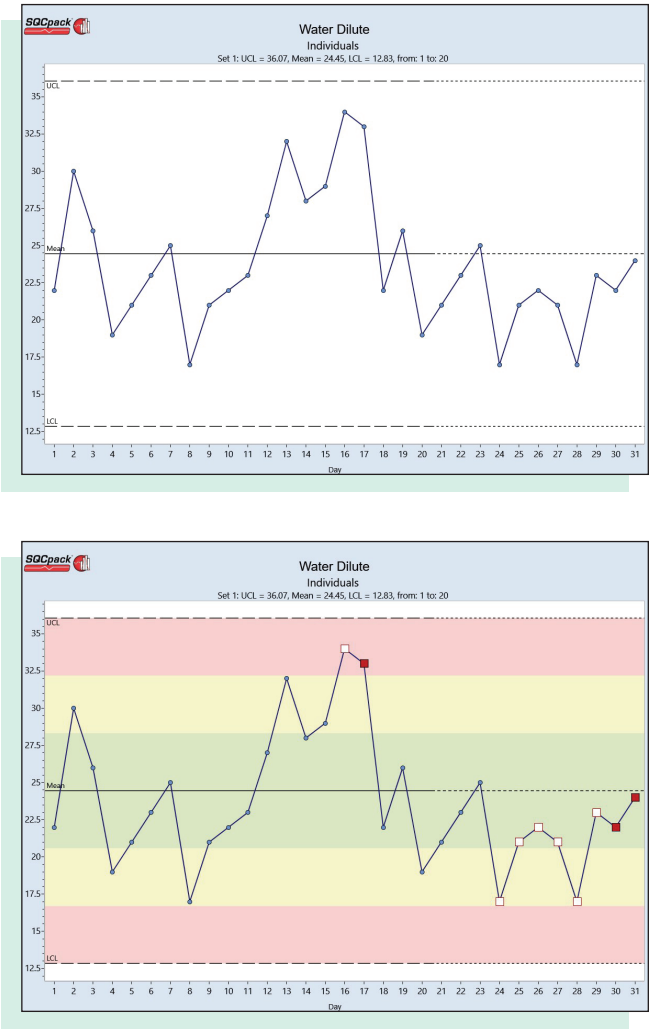
5. Out-of-control conditions clearly identified

Some out-of-control conditions are easy to spot. A point above the upper control limit or below the lower control limit is usually obvious. However, other conditions can be more difficult to see. For example, the run rules, such as seven points increasing or decreasing, and the zone rules, such as two points beyond two sigma can be hard to pick up at a glance. In these cases, the software should help by visually showing a difference and by showing the points that contribute to the out-of-control conditions on the chart.

Same data set shown with and without clear out-of-control information.



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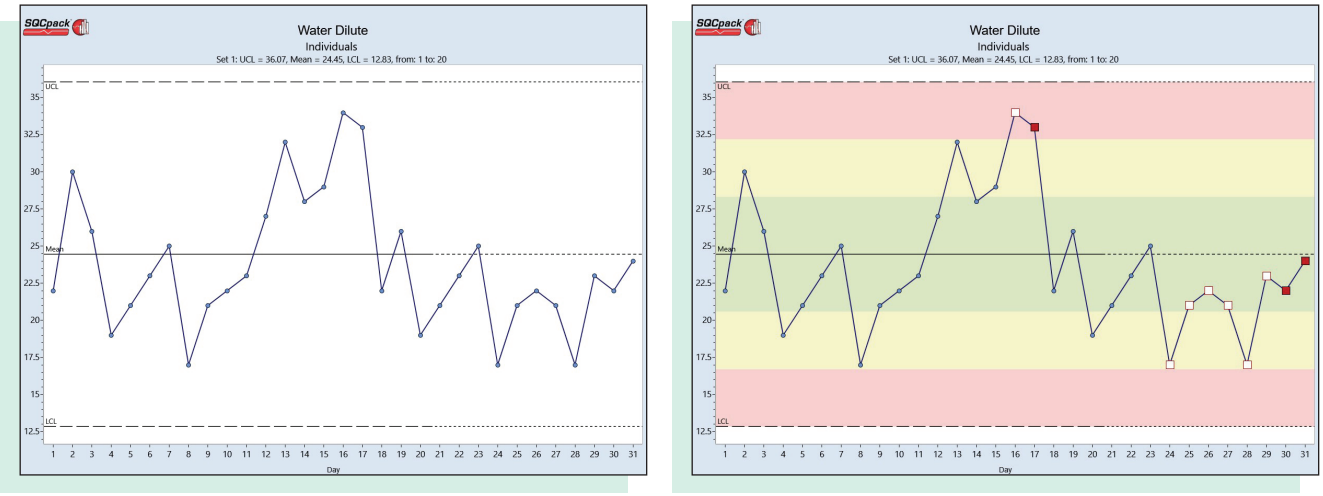
6. Assignable causes shown but not used in overall calculations

When data is being collected on a key metric for use in a control chart, you are likely to encounter unusual data values. These values can be significantly different from the typical values—different enough to distort the control limits and change the scale of the control chart. Usually, some reason or special cause can be found for these values.

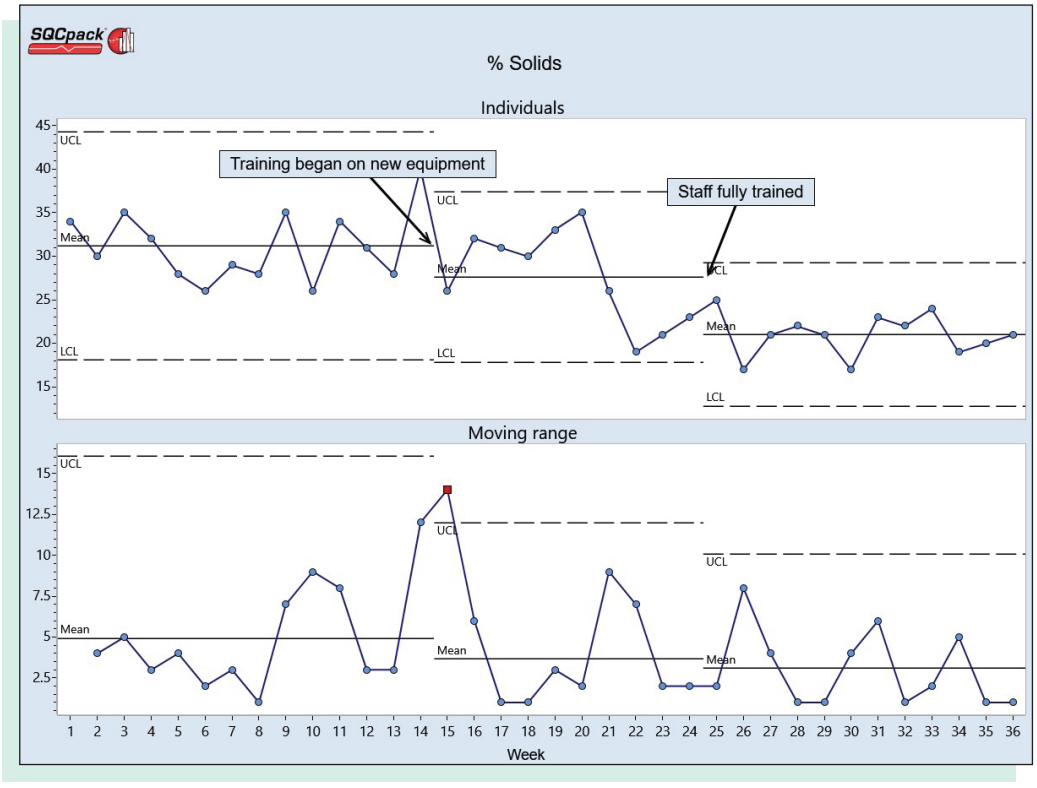
One needs to record these data points for historical study, but without affecting the control limit calculations. SPC software should have a mechanism for handling assignable causes. When a point is marked with an assignable cause, it should show up on the control chart, but it should not be included in the calculations, and it should be visually different from the other data points.



The caused data point is visible, but not included in calculations on the second chart.

7. Annotations used to increase understanding

Sometimes, a word is worth a thousand pictures. A control chart can be made much more useful with the addition of some well-placed text, lines, and/or arrows. These chart annotations can document process changes or note important events that affect the chart. As long as you are careful not to overuse them, annotations can be an important addition to most control charts.



More on software

Software is an outstanding tool for creating control charts, but software by itself cannot help you improve. Improvement will come from the data-based decisions you make after interpreting the charts. That's why your software tool should have the features and flexibility to make the charts easy to interpret. If you follow the seven guidelines presented in this paper, you'll be well on your way to selecting the best software for creating healthy control charts.

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